NPRST Auction Research in Support of Sea Warrior CMS

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Achieving Human Resource Solutions Through Innovative Research

Background

- **FY03**
  Developed experimental software environment
  - Results to empirically inform the auction design

- **FY04**
  Continued experimental auction to inform the auction design
  - Southern Methodist University
  - University of Mississippi
  - University of Memphis

  Closer integration with Sea Warrior team to test and evaluate the Sea Warrior CMS compatible, research-driven, advanced auction functionality and design

Efficiency and Auction Design Research

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- **Basic Research Addresses a Few Fundamental Questions**

  How and what weight to apply to the Sailor's bid?

  Which auction format is more efficient? (1st vs. 2nd Price)

  Does contention level matter?

1st Price vs. Generalized 2nd Price Auction

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1st Price Auction

- **Bid Weight = 2%**
- **Max Bid = $500**

- **Bids Received**

  $500

  $500

  $500

Generalized 2nd Price Auction

- **Bid Weight = 2%**
- **Max Bid = $500**

- **Bids Received**

1st Price vs. Generalized 2nd Price Auction

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1st Price Auction

- **Bid Weight = 2%**
- **Max Bid = $500**

- **Bids Received**

  $500

  $500

  $500

Generalized 2nd Price Auction

- **Bid Weight = 2%**
- **Max Bid = $500**

- **Bids Received**

  $500

  $350

  $250

Basic Structure of the Experiments

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- **Subjects are presented with list of jobs**
- **Total Score = Fitness Score + Bid Score**
- **For each job their reservation wage is given**
- **For the awarded job the subject receives Points = Bid-RW**
- **Subjects exchange their points for US dollars at a pre-announced exchange rate**

Experimental Auction Environment Subject's Screens

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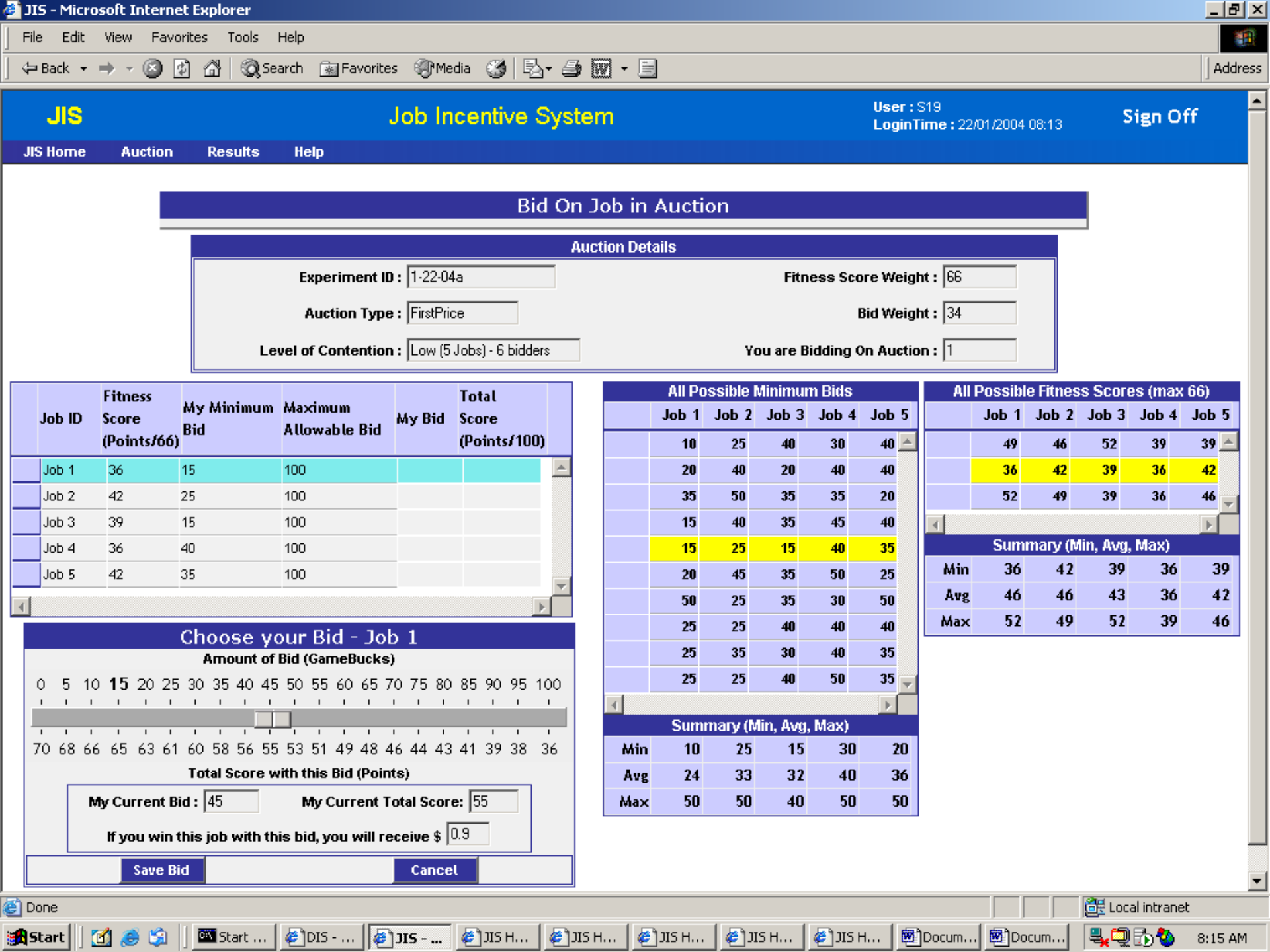
JIS - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media Address
JIS
Job Incentive System
User : S19
LoginTime : 22/01/2004 08:13
Sign Off
JIS Home Auction Results Help
Bid On Job in Auction
Auction Details
Experiment ID : 1-22-04a
Fitness Score Weight : 66
Auction Type : FirstPrice
Bid Weight : 34
Level of Contention : Low (5 Jobs) - 6 bidders
You are Bidding On Auction : 1
Job ID | Fitness Score (Points/66) | My Minimum Bid | Maximum Allowable Bid | My Bid | Total Score (Points/100)
Job 1 36 15 100
Job 2 42 25 100
Job 3 39 15 100
Job 4 36 40 100
Job 5 42 35 100
All Possible Minimum Bids
Job 1 Job 2 Job 3 Job 4 Job 5
10 25 40 30 40
20 40 20 40 40
35 50 35 35 20
15 40 35 45 40
15 25 15 40 35
20 45 35 50 25
50 25 35 30 50
25 25 40 40 40
25 35 30 40 35
25 25 40 50 35
Summary (Min, Avg, Max)
Min 10 25 15 30 20
Avg 24 33 32 40 36
Max 50 50 40 50 50
All Possible Fitness Scores (max 66)
Job 1 Job 2 Job 3 Job 4 Job 5
49 46 52 39 39
36 42 39 36 42
52 49 39 36 46
Summary (Min, Avg, Max)
Min 36 42 39 36 39
Avg 46 46 43 36 42
Max 52 49 52 39 46
Choose your Bid - Job 1
Amount of Bid (GameBucks)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
70 68 66 65 63 61 60 58 56 55 53 51 49 48 46 44 43 41 39 38 36
Total Score with this Bid (Points)
My Current Bid : 45
My Current Total Score: 55
If you win this job with this bid, you will receive $ 0.9
Save Bid
Cancel
Done
Local intranet
Start
8:15 AM

Experimental Auction Environment: Selected Researcher Screens

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Researcher Post Experiment Review

Session Name :	Session 2	**Experiment Name :**	first test	**Navy MOE Weight :**	0
Core Set Name :	Populated Valid Core	**Auction Type :**	FirstPrice	**Sailor Bid Weight :**	100
Contention Level :	Low	**# Of Completed Auctions :**	3	**Command Subsidy Weight :**	0

Award History

User	Cummulative Payment (USD $)
ramg	0.0
sa	0.0
sailor	0.0
zhossam	0.0
Total	**0.0**

Experiment MOEs

Aggregate Consumer Surplus	0.0
Aggregate Total Wage Bill	0.0
Aggregate Total Labor Cost	0.0
Aggregate Total Fitness Level	0.0
Aggregate Bidding Factor	0.0
Overall Efficiency	0.0

Close

Selected Measures of Effectiveness for Alternative Auction Formats

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Overall Efficiency (OE)

$$OE = \frac{\sum_{i=1}^{6}\sum_{j=1}^{J}\sum_{k=1}^{20} z_{ijk}x_{ijk}}{OE^{*}}, \text{ where } OE^{*} = \sum_{i=1}^{6}\sum_{j=1}^{J}\sum_{k=1}^{20} z^{*}_{ijk}x^{*}_{ijk}$$

where

z = the total fitness scores

x = the assignment

OE^{*} is OE computed by replacing the bids with the Sailors' true reservation wages.

This index measures the extent to which a given mechanism achieves the "ideal" value of the objective function. If Sailors do bid truthfully under a given mechanism, then the efficient outcome will be achieved and the index will take on a value of 1. If Sailors inflate their bids, then the aggregate fitness scores fall and so the overall score of the assigned Sailors will fall too. This causes the index to be less than 1.

Selected Measures of Effectiveness for Alternative Auction Formats

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Bidding Efficiency (BE)

These are two measures used to test for systematic deviations from truthful revelation.

$$BE = \frac{\sum_{i=1}^{6}\sum_{j=1}^{J}\sum_{k=1}^{20} b_{ijk}}{\sum_{i=1}^{6}\sum_{j=1}^{J}\sum_{k=1}^{20} c_{ijk}}$$, where b's are the bids and c's are the Sailor's reservation wages.

Truthful disclosure occurs if $BE = 1$.

$b_{ijk} = \hat{\beta}_0 + \hat{\beta}_1 c_{ijk} + \hat{\beta}_2 f_{ijk} + e_{ijk}$ is an OLS regression

Truthful disclosure occurs if $\hat{\beta}_0 = \hat{\beta}_2 = 0$ and $\hat{\beta}_1 = 1$.